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(54) A method of and apparatus for transporting an object to an underwater location.

(57) A method of and apparatus for transporting an object to an underwater location is described. The apparatus comprises a floating submersible structure 1 having a pay load area 5. The structure 1 comprises ballast tanks 3, 4 which may be filled with or emptied of ballast to alter the buoyancy of the submersible structure 1. Pulling means 6 is mounted on the structure 1 and connection means 10 are provided for coupling the structure 1 to the bottom of the body of water (23, fig 4b). The connection means 10 engages the pulling means 6 and the pulling means 6 is adapted to pull the submersible structure 1 to the bottom by pulling on the connection means 10 when the connection means is coupled to the bottom e.g. by the provision of anchors (27).

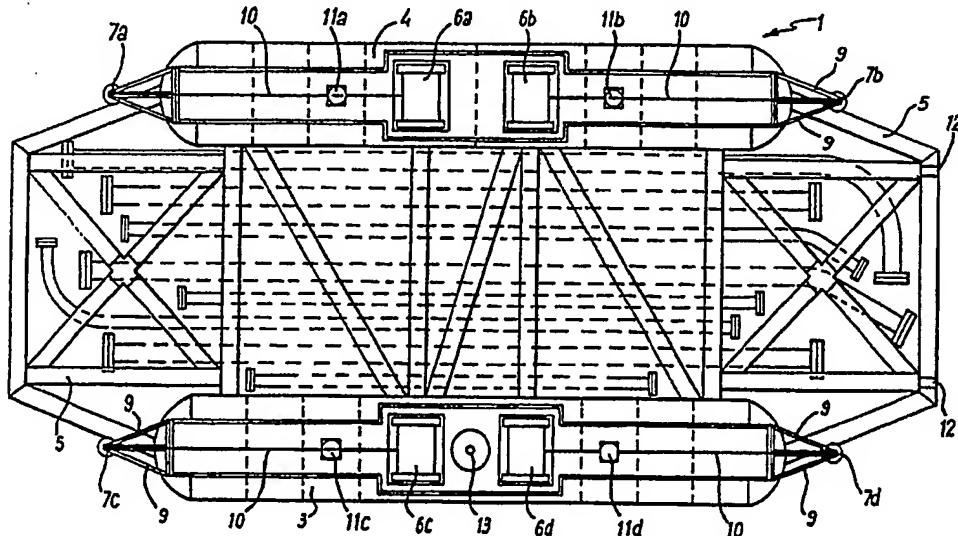


Fig. 3

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filling to enable the application to comply.

FIG. 2

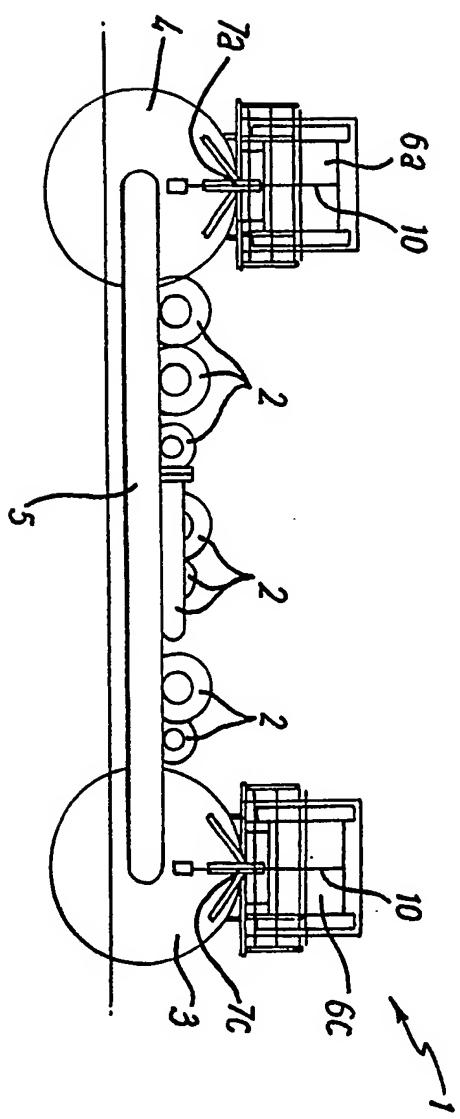
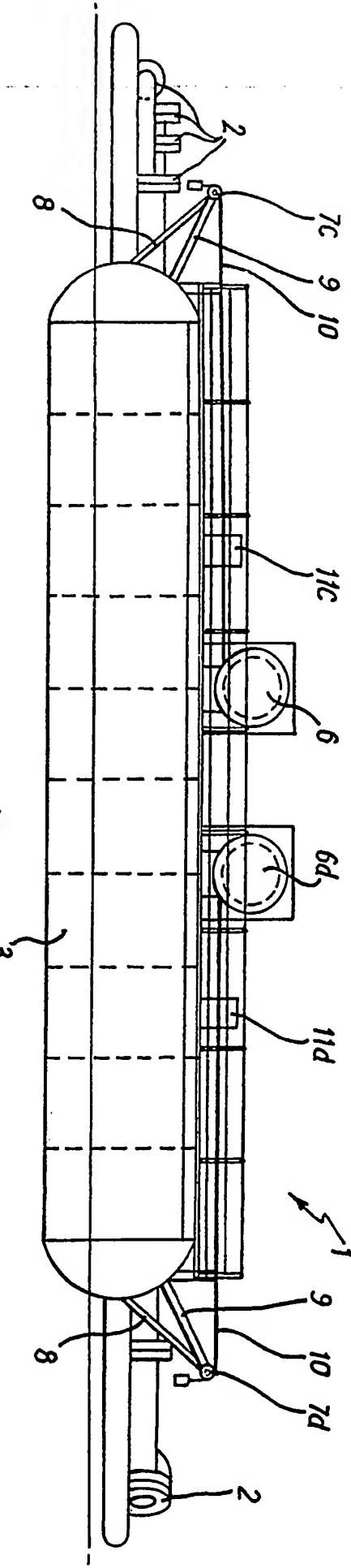
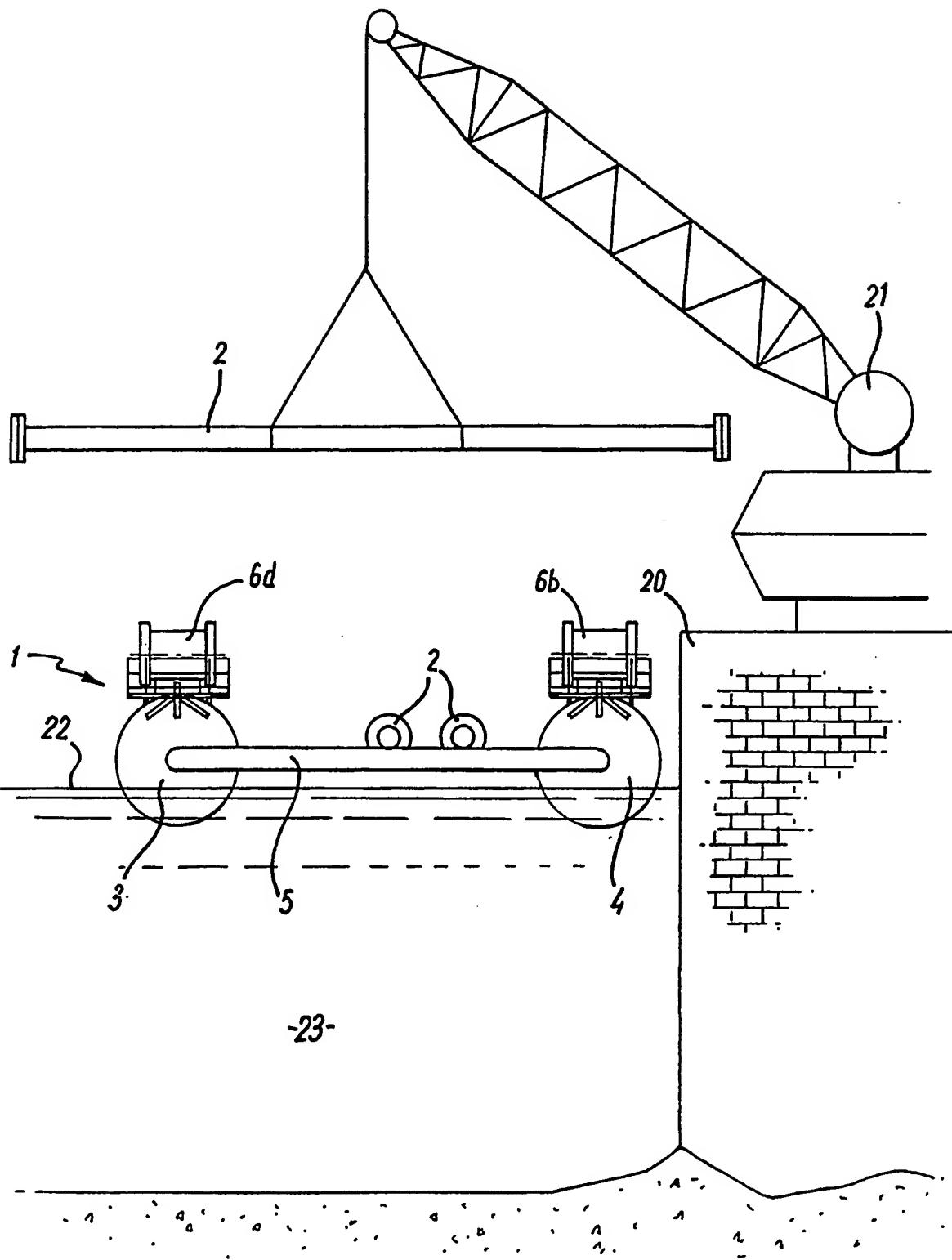


FIG. 1



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FIG. 4a

$4\frac{1}{8}$

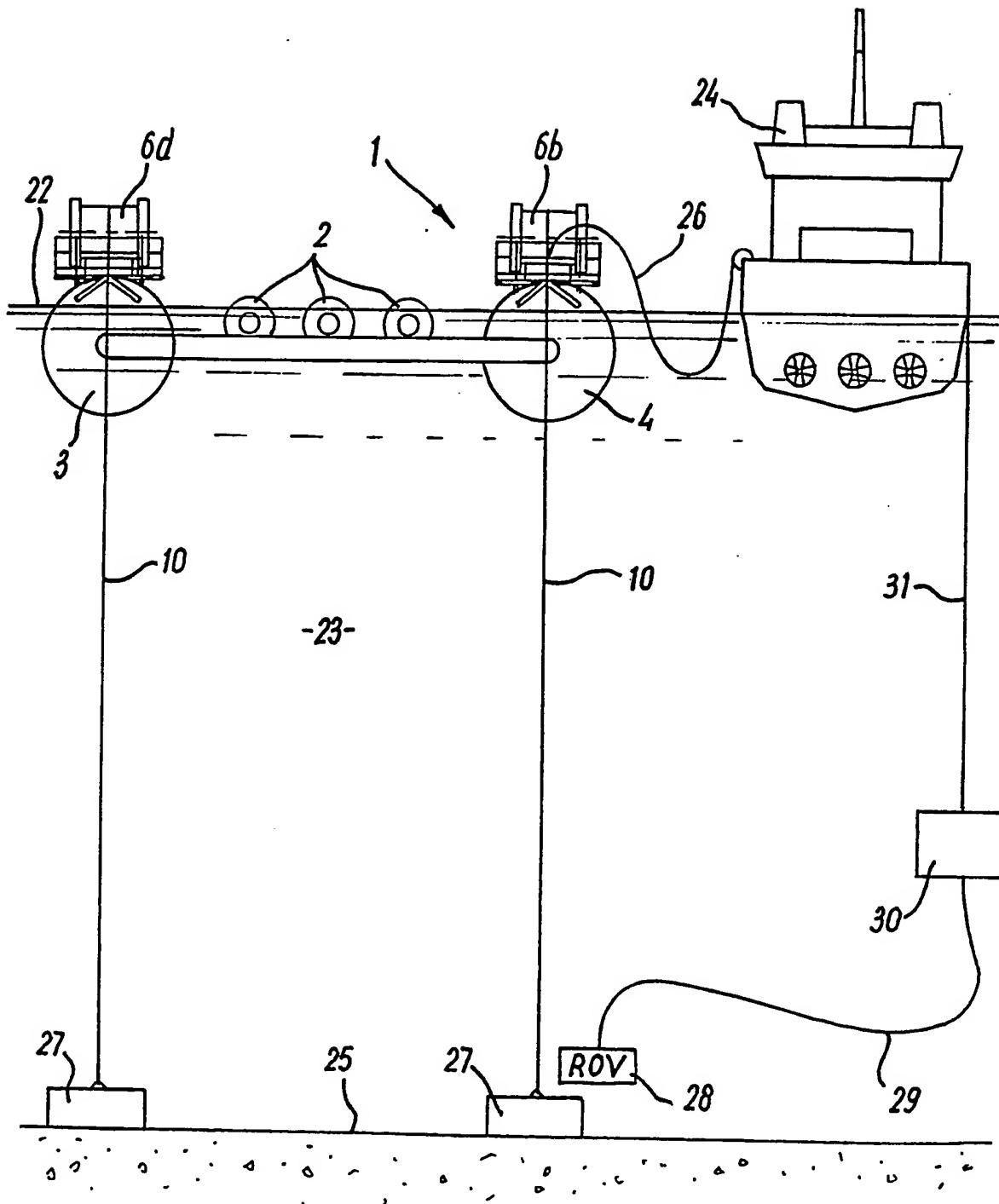


FIG. 4b

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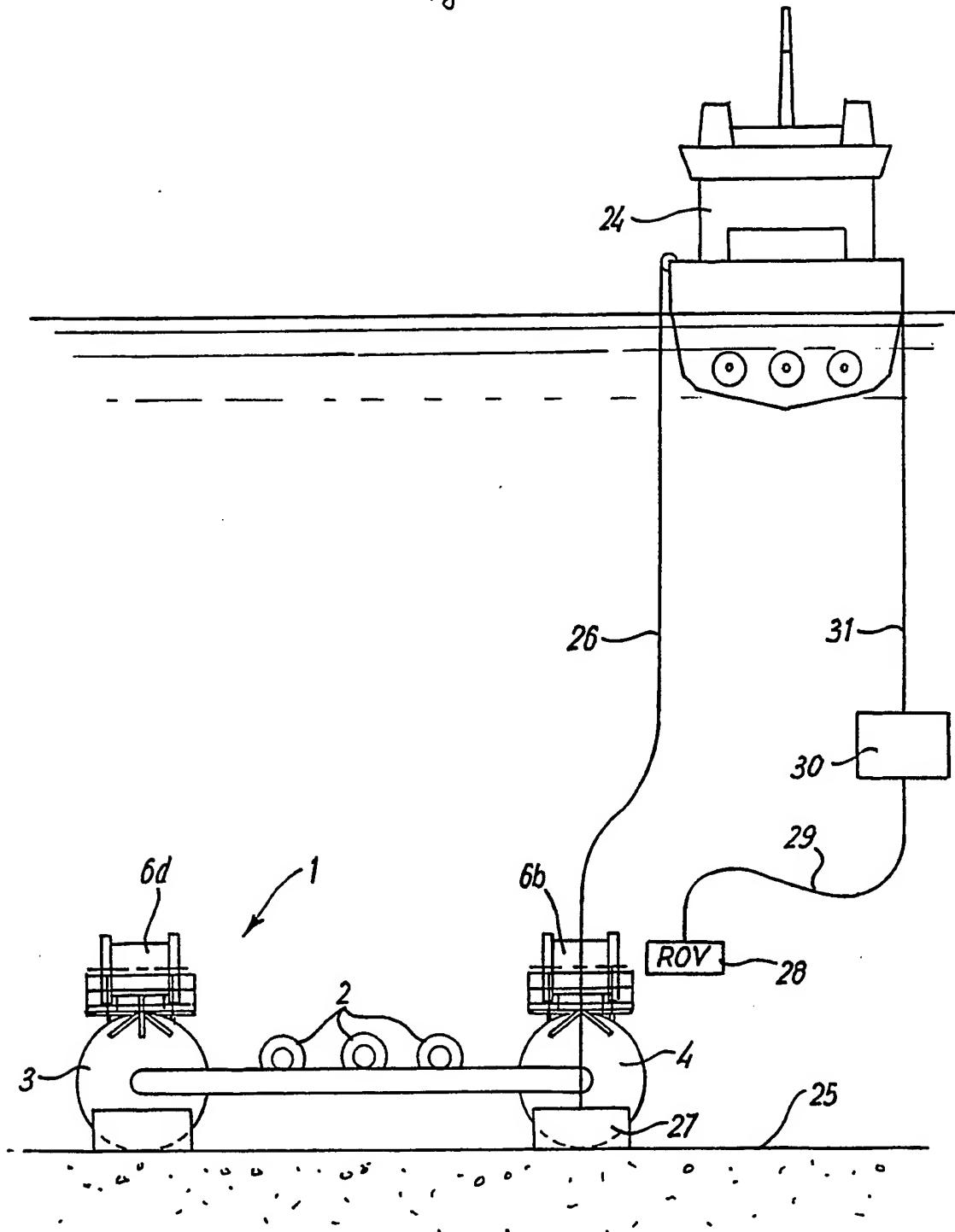


FIG. 4C

$6\frac{1}{8}$

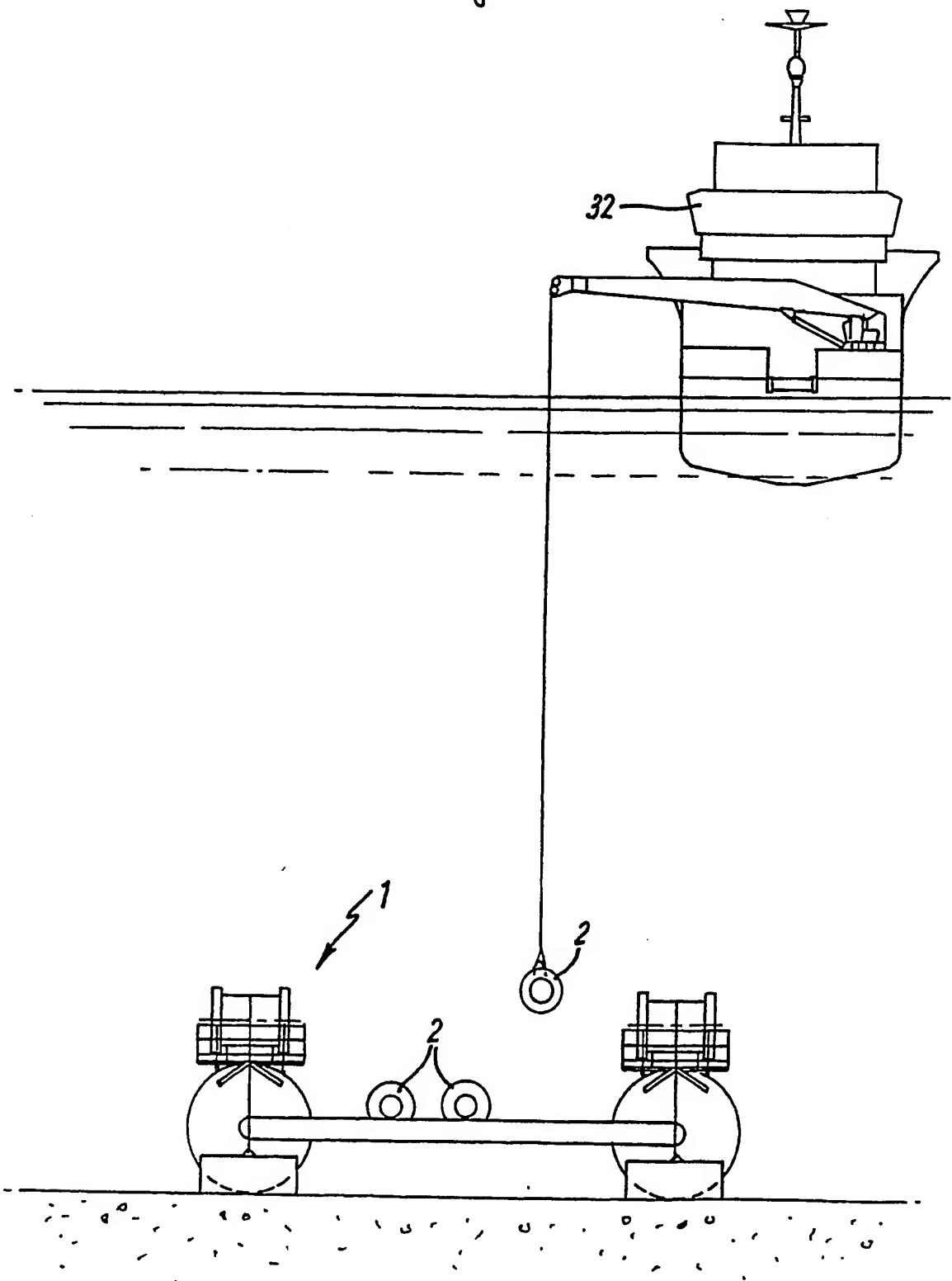


FIG. 4d

$\frac{7}{8}$

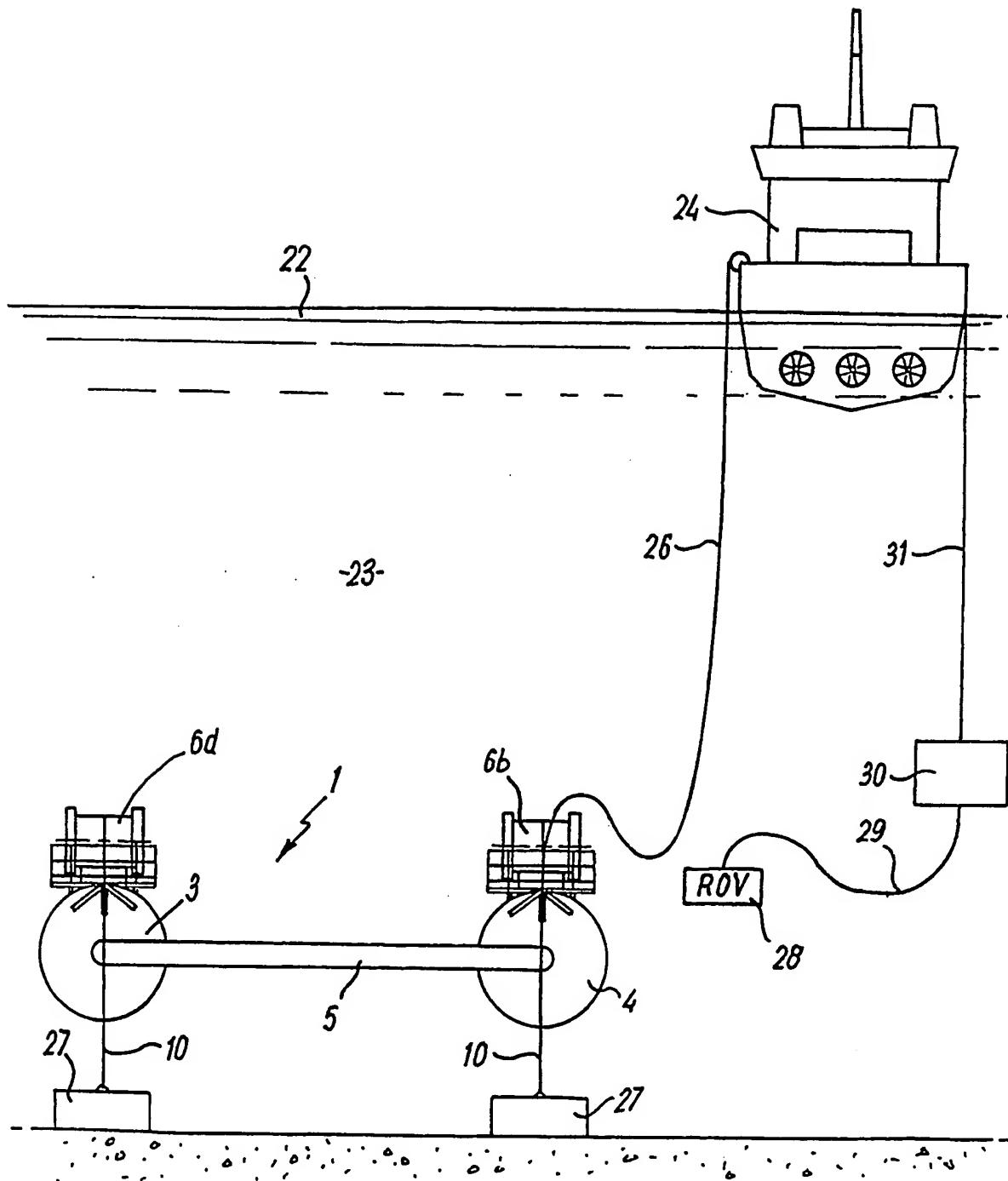


FIG. 4e

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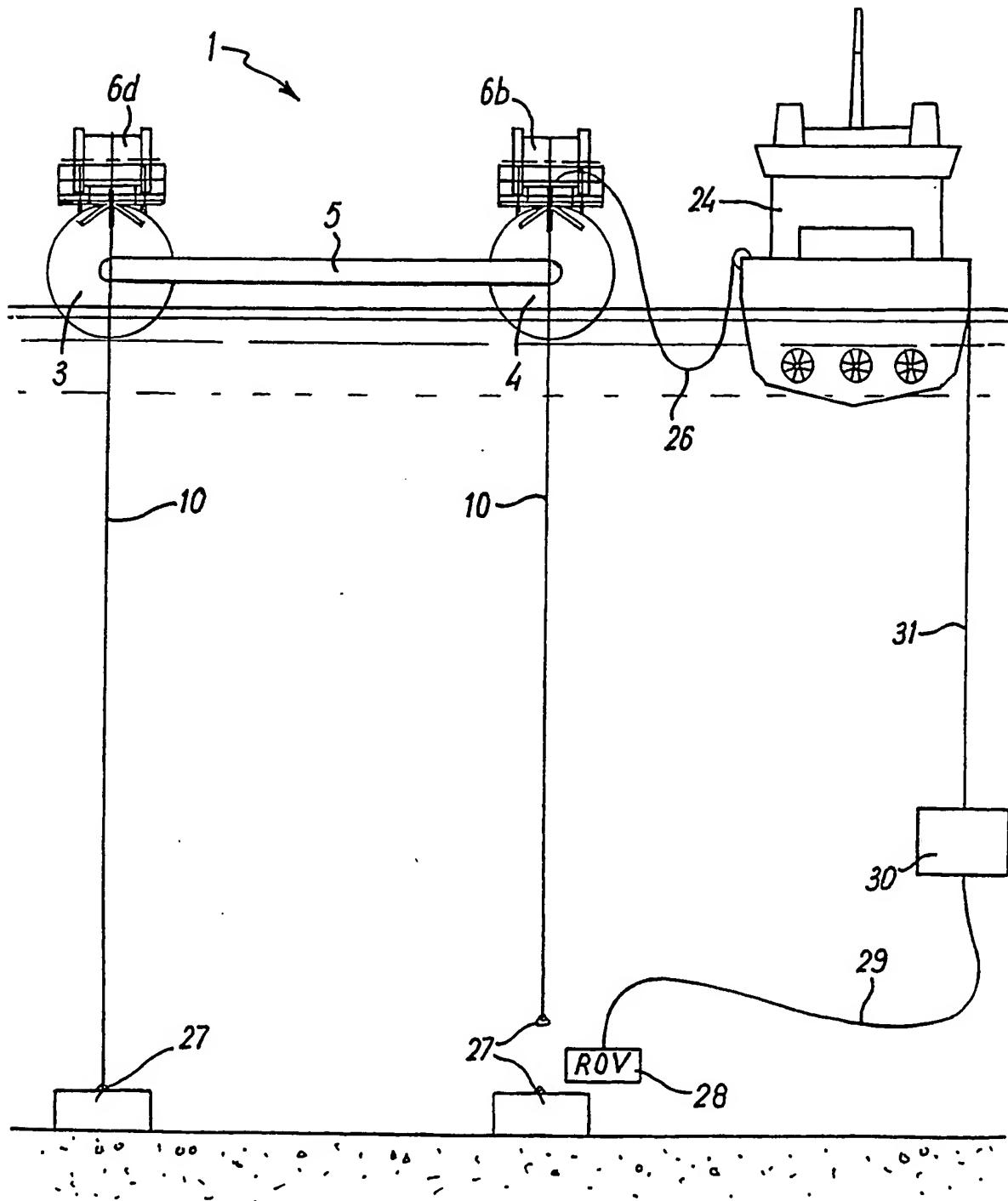


FIG. 4f

1 "A Method of and Apparatus for Transporting an Object
2 to an Underwater Location"

3

4 The invention relates to a method of and apparatus for
5 transporting objects to an underwater location.

6

7 Conventional methods of moving heavy and bulky objects
8 offshore to an underwater location have involved using
9 a vessel to transport the object to above the
10 underwater location and then using a crane barge to
11 lift the object from the vessel and lower it into
12 location underwater.

13

14 This previous method has the disadvantage that both
15 vessels are required to be on location simultaneously
16 during the unloading operation. With bulky objects it
17 may be necessary to use a relatively large crane arm
18 radius which can result in requiring a large and
19 therefore expensive crane to manoeuvre the load into
20 position. Typically, the load capacity of a crane
21 reduces with the increase in radius of the lifting
22 point from the central crane support and often this
23 reduction can be very rapid. For example, a crane may
24 have a load capacity of 30 tons at a radius of 20

1 metres but a load capacity of only 5 tons at a radius
2 of 24 metres.

3

4 In accordance with an aspect of the present invention,
5 a method of transporting an object to an underwater
6 location comprises placing the object on a floating
7 submersible structure, propelling the submersible
8 structure with the object to a location on the surface
9 of the water in the vicinity of the underwater
10 location, coupling the submersible structure to the
11 bottom of the body of water below the submersible
12 structure and submersing the submersible structure by
13 pulling the submersible structure to the bottom while
14 maintaining a positive buoyancy in the submersible
15 structure.

16

17 In one example of the method, the object may be
18 subsequently moved from the submersible structure to
19 the underwater location. However, in another example
20 of the method, the object is situated in the underwater
21 location when the submersible structure reaches the
22 bottom of the body of water.

23

24 In the first example, the submersible structure may be
25 recovered from the bottom and re-used. In the second
26 example, the submersible structure remains at the
27 underwater location and may be used to recover the
28 object at a later date.

29

30 In accordance with another aspect of the present
31 invention, apparatus for transporting an object to an
32 underwater location comprises a floating submersible
33 structure having a pay load area, the structure
34 comprising a ballast tank which may be filled with or
35 emptied of ballast to alter the buoyancy of the

1 submersible structure, pulling means mounted on the
2 structure and connection means for coupling the
3 structure to the bottom of the body of water, the
4 connection means engaging the pulling means wherein the
5 pulling means is adapted to pull the submersible
6 structure to the bottom by pulling on the connection
7 means when the connection means is coupled to the
8 bottom.

9

10 Typically, the connection means may be a cable or chain
11 and may be coupled to the bottom by means of an anchor
12 device which for example, could be a heavy weight which
13 couples the connection means to the bottom by means of
14 its own weight or alternatively, could be by means of a
15 releasable connector having one section fixed to the
16 sea bed and the other section fixed to the coupling
17 means, whereby the two sections engage with each other
18 to couple the connection means to the bottom.

19

20 In one example, the anchor device could be
21 transportable and could be carried on the apparatus
22 when transporting the object to the underwater
23 location.

24

25 Typically, a number of pulling means are provided and
26 preferably, a connection means is associated with each
27 pulling means. In the preferred arrangement, four
28 pulling means and four connection means are provided.

29

30 Preferably, the pulling means may be in the form of
31 winding means, such as a winch and the connection means
32 is typically wound round the winding means.

33

34 Typically, the apparatus may also include a tension
35 monitor to monitor the tension in the connection means.

1 Typically, the buoyancy of the submersible structure is
2 alterable on feedback received from the tension
3 monitor. Preferably, a tension monitor is provided for
4 each connection means, where appropriate.

5

6 Preferably, the apparatus includes towing means to
7 permit the apparatus to be towed to the location.
8 Alternatively, it is possible that the apparatus could
9 be fitted with self propulsion means.

10

11 Typically, the apparatus is not normally manned and the
12 operation of the pulling means and ballast of the
13 buoyancy means may be adjusted by use of a control line
14 connecting the apparatus to another structure, which
15 may be a floating structure such as a ship. The
16 control line may be in the form of an umbilical
17 connection.

18

19 A method of and apparatus for transporting an object to
20 an underwater location in accordance with the invention
21 will now be described with reference to the
22 accompanying drawings, in which:-

23

24 Fig. 1 is a side view of the apparatus;
25 Fig. 2 is an end view of the apparatus;
26 Fig. 3 is a plan view of the apparatus; and
27 Figs. 4A to 4F show the apparatus of Figs. 1 to 3
28 in use.

29

30 Fig. 1 is a side view of apparatus 1 for transporting
31 objects to an underwater location. In this example,
32 the objects shown are lengths of pipe 2 which are to be
33 installed in the seabed. The apparatus 1 comprises two
34 large tubular members 3, 4 which form ballast tanks and
35 permit the buoyancy of the apparatus 1 to be adjusted.

1 The tubular members 3, 4 are interconnected by a
2 framework 5 which extends between the tubular members
3, 4 and provides a pay load platform for the lengths
4 of pipe 2. Mounted on the tubular members 3, 4 are
5 four marine winches 6a, 6b, 6c, 6d two winches being
6 mounted on each tubular member, as shown in Figs. 1 to
7 3. Fairleads 7a, 7b, 7c, 7d are mounted at each end of
8 the tubular members 3, 4 by means of supporting struts
9 8, 9. The fairleads convey cable 10 from the
10 respective winch 6a to 6d over each end of the tubular
11 members 3, 4. Located between each marine winch 6a-6d
12 and each respective fairlead 7a-7d is a tension monitor
13 11a, 11b, 11c, 11d to monitor the tension in the cables
14 10. The apparatus 1 is also provided with towing
15 points 12 to permit the apparatus 1 to be towed behind
16 a vessel. The tubular members 3, 4 are also provided
17 with valve devices (not shown) to permit the tubular
18 members 3, 4 to be flooded with water or alternatively
19 to enable the tubular members to have water pumped out
20 from them. An umbilical connection point 13 is
21 provided on the top surface of tubular member 3 and
22 this is coupled to the winches 6a-6d, tension monitors
23 11a-11d and valve devices, to control their operation.
24

25 In use, the apparatus 1 is moored beside a dock 20 and
26 lengths of pipe 2 are lowered onto the pay load support
27 area formed by the frame 5 by a conventional dockside
28 crane 21, as shown in Fig. 4A. After loading the
29 lengths of pipe 2 onto the apparatus 1, the tubular
30 members 3, 4 have their ballast adjusted to ensure that
31 the apparatus 1 is properly balanced and that it is
32 floating correctly on surface 22 of water 23.

33

34 The apparatus 1 with the pipes 2 is then towed by a
35 vessel 24 to the desired location above seabed 25 and

1 an umbilical 26 connected to the connection 13 between
2 the vessel 24 and the connection 13 to control the
3 operation of the winches 6a-6d and ballasting of the
4 tubular member 3, 4 from the vessel 24. The winches
5 6a-6d are operated to unwind cable 10 to the seabed
6 where they may be anchored by means of anchors 27.

7

8 The anchors 27 could be permanently fixed to the seabed
9 or could be transportable and carried on the apparatus
10 1 during towing.

11

12 The anchors 27 may be heavy weights, such as concrete
13 blocks, or alternatively, could take the form of
14 connectors which releasably engage cable 10 with the
15 seabed 25 and in this case a remotely operated vehicle
16 (ROV) 28 operating via an umbilical 29 from a tether
17 station or garage 30, which is connected to the vessel
18 24 by an umbilical 31, could be used to facilitate
19 connection of the cables 10 to the anchors, as shown in
20 Fig. 4B. The tubular members 3, 4 are flooded to
21 decrease the buoyancy of the apparatus 1 until the
22 apparatus 1 has a buoyancy which is less than the total
23 load which may be exerted using the four winches 6a-6d.
24 When this condition is reached, operation of the
25 winches 6a-6d to wind in the cable 10 will cause the
26 apparatus 1 to become submerged as the winches 6a-6d
27 pull the apparatus 1 towards the seabed 25. During
28 this operation, the tension monitors 11a-11d monitor
29 the tension in cables 10, to ensure the apparatus 1 is
30 correctly balanced and no excess land is present on the
31 cables 10. If necessary the buoyancy of the apparatus
32 can be adjusted accordingly. When the apparatus 1
33 reaches the seabed 25, as shown in Fig. 4C, the tubular
34 members 3, 4 are fully ballasted to minimise any
35 possible movement of the apparatus 1 on the seabed and

1 the ROV 28 may then disconnect the umbilical 26 from
2 connection 13 to permit the vessel 24 to leave the
3 apparatus 1 with pipes 2 moored on the seabed 25.

4

5 A crane on a vessel 32 may then be used to transfer the
6 lengths of pipe 2 from the apparatus 1 to the
7 appropriate location on the seabed and divers and/or
8 ROVs may be used, if appropriate, to assist in the
9 final location (See Fig. 4D).

10

11 After the lengths of pipe 2 have been removed from the
12 apparatus 1, the vessel 24 (or a different vessel) may
13 return to the location and the umbilical 26 reconnected
14 to the umbilical connection point 13 on the apparatus 1
15 by the ROV 28 and the tubular members 3, 4 unballasted,
16 for example by pumping air or another gas into the
17 tubular members 3, 4 to expel some of the water to make
18 the apparatus 1 buoyant. Hence, as the winches are
19 operated to unwind cable 10, the apparatus 1 rises to
20 the surface 22 of the water 23, as shown in Fig. 4E.

21

22 When the apparatus 1 is on the surface, the ROV may be
23 used to disconnect the anchors 27 and the cable 10
24 wound back onto the winches 6a-6d. The apparatus 1 may
25 then be towed back to dock and reused as necessary.

26

27 Hence, the invention has the advantage of providing a
28 method and apparatus for transporting objects to an
29 underwater location by only lifting the objects while
30 they are submerged. This permits a lower crane
31 capacity to be used as the weight required to be lifted
32 is only the submerged weight of the object and not the
33 weight of the object in air and in addition, the crane
34 may be located above the object being lifted to reduce
35 the radius of the boom of the crane to permit a lower

1 capacity crane to be used for the lifting operation.

2

3 In addition, the invention also has the advantage that
4 only the vessel on which the crane is located is moving
5 on the water. This mitigates the dangers and problems
6 associated with lifting objects from another moving
7 vessel on the sea where relative movement between the
8 vessel on which the crane is located and the vessel on
9 which the objects being removed are located can cause
10 problems.

11

12 Also, because relative movement between vessels is
13 mitigated, the conditions which can be tolerated during
14 the operations can be more extreme.

15

16 Furthermore it is not essential that the crane vessel
17 and the vessel 24 which locates the apparatus 1 are at
18 the location simultaneously which can be expensive if
19 there are delays in the unloading operations.

20

21 Modifications and improvements may be incorporated
22 without parting from the scope of the invention.

23

1 CLAIMS

2

3 1. A method of transporting an object to an
4 underwater location comprising placing the object on a
5 floating submersible structure, propelling the
6 submersible structure with the object to a location on
7 the surface of the water in the vicinity of the
8 underwater location, coupling the submersible structure
9 to the bottom of the body of water below the
10 submersible structure, submersing the submersible
11 structure by pulling the submersible structure to the
12 bottom while maintaining a positive buoyancy in the
13 submersible structure, and locating the object at the
14 underwater location.

15

16 2. A method according to claim 1, wherein the object
17 is moved from the submersible structure to the
18 underwater location after the submersible structure has
19 reached the bottom.

20

21 3. A method according to claim 1, wherein the object
22 is situated in the underwater location when the
23 submersible structure reaches the bottom of the body of
24 water.

25

26 4. A method according to claim 2 or claim 3, wherein
27 the submersible structure is used to recover the object
28 from the underwater location.

29

30 5. Apparatus for transporting an object to an
31 underwater location comprising a floating submersible
32 structure having a pay load area, the structure
33 comprising a ballast tank which may be filled with or
34 emptied of ballast to alter the buoyancy of the
35 submersible structure, pulling means mounted on the

1 structure and connection means for coupling the
2 structure to the bottom of the body of water, the
3 connection means engaging the pulling means wherein the
4 pulling means is adapted to pull the submersible
5 structure to the bottom by pulling on the connection
6 means when the connection means is coupled to the
7 bottom.

8

9 6. Apparatus according to claim 5, wherein the
10 connection means is coupled to the bottom by means of
11 an anchor device.

12

13 7. Apparatus according to claim 6, wherein the anchor
14 device comprises a releasable connector to releasably
15 connect the connection means to the anchor device.

16

17 8. Apparatus according to claim 6 or claim 7, wherein
18 the anchor device is carried on the apparatus when
19 transporting the object to the underwater location.

20

21 9. Apparatus according to any of claims 5 to 8,
22 wherein the pulling means is in the form of a winding
23 means.

24

25 10. Apparatus according to any of claims 5 to 9,
26 wherein the apparatus also includes a tension monitor
27 to monitor the tension in the connection means.

28

29 11. Apparatus according to claim 10, the apparatus
30 also including buoyancy control means which controls
31 the buoyancy of the submersible structure in response
32 to signals received from the tension monitor.

33

34 12. Apparatus according to any of claims 5 to 11,
35 wherein a number of connection means are provided.

1 13. Apparatus according to claim 12, wherein four
2 connection means are provided.

3

4 14. Apparatus according to claim 12 or claim 13,
5 wherein a pulling means is provided for each connection
6 means.

7

8 15. Apparatus according to any of claims 5 to 14,
9 wherein the apparatus includes a control line to couple
10 the apparatus to a control centre on another floating
11 structure to permit the apparatus to be controlled
12 remotely from the other floating structure.

13

14 16. Apparatus for transporting an object to an
15 underwater location, substantially as hereinbefore
16 described with reference to any of the accompanying
17 drawings.

18

19 17. A method of transporting an object to an
20 underwater location, substantially as hereinbefore
21 described with reference to any of the accompanying
22 drawings.

23

Relevant Technical Fields	Search Examiner A HABBIJAM
(i) UK Cl (Ed.M) E1H (HEA); B7V (VEA); B7A (AGT)	Date of completion of Search
(ii) Int Cl (Ed.5) B63B 35/00, 35/44; E02B 17/00, 17/02	18 JULY 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications.	Documents considered relevant following a search in respect of Claims :- 1-17

(ii)

Categories of documents

- X: Document indicating lack of novelty or of inventive step. P: Document published on or after the declared priority date but before the filing date of the present application.
- Y: Document indicating lack of inventive step if combined with one or more other documents of the same category. E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.
- A: Document indicating technological background and/or state of the art. &: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1545500	(AYLMER OFFSHORE LTD) See in particular Figures 1 and 10	1, 3-9, 12, 14
X	GB 0980575	(LASSEN-NIELSEN) See especially Figure 2 and related description	1-3, 5, 6, 9, 12, 14